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Correlation between voice handicap index and voice laboratory measurements in dysphonic patients

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Abstract Factors underlying voice disorders can be categorized into three distinct domains: emotional, physical, and functional. The Voice Handicap Index (VHI) subjectively evaluates voice disorders in terms of these three factors. On the other hand, Voice Laboratory Measurements (VLM) use objective criteria to evaluate the severity of voice disorders. Use of these two different tests (VHI and VLM) on dysphonic patients has, however, tended to yield results that vary widely in their conclusions. This report reviewed 135 testing sessions on dysphonia patients. Seventy-nine of the tests were VHI, and 56 were VLM. All VHI and VLM parameters were entered into a statistical program and analyzed using a Pearson correlation. The results show that each VHI parameter provides a significant level of reliability ($P < 0.01$) when compared with other VHI parameters. Four VLM parameters also demonstrated significant reliability ($P < 0.01$) in comparison with other VLM parameters. However, when comparing across testing methods, VHI and VLM parameter reliability is shown to be poor ($P > 0.05$). With such a large discrepancy between the results of VHI and VLM testing, no objective parameter can yet be regarded as a definitive prognostic factor in a subjective evaluation of dysphonic patients.

Keywords Voice handicap index · Voice laboratory measurements

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Introduction

The World Health Organization defines health as a multidimensional concept incorporating physical, mental and social states of being [5]. However, traditional medical concepts tend to give the greatest priority to the physical condition of patients – often overlooking entirely patients' emotional and social states in clinical treatment. In dysphonic patients, most therapists focus their treatment on the physical aspects of voice. However, vocal cord dysfunction manifests itself differently amongst different patient groups (such as teachers, housewives, etc.).

The Voice Handicap Index (VHI) was developed to allow patients' subjective feelings regarding their voice disorder to help guide therapist decisions regarding effective voice disorder treatment [3]. This self-assessment consists of ten items in the three domains emotional, physical and functional. Although a subjective evaluation based on a patient's own perception, VHI can provide valuable insight into why patients with similar voice disorders experience dissimilar levels of handicap severity.

Voice Laboratory Measurements (VLM) can be assessed using perceptual acoustic analysis and maximal phonation time (MFT) [1]. Acoustic analysis employs a variety of parameters, including jitter (frequency perturbation), shimmer (amplitude perturbation) and the noise-to-harmonic ratio, in order to evaluate slight changes of mass and tension in, as well as the biomechanical character of, vocal chords. MFT can provide insights regarding respiratory function control, glottic efficiency and laryngeal control [1]. It also provides variables that permit assessment of a patient's level of impairment against the norms of properly functioning vocal systems. VLM is routinely used to evaluate, in an objective manner, dysphonic patients before and after treatment.

VHI is a newly developed method used in the treatment of dysphonic patients. It enables researchers to obtain more information about patients' subjective perceptions and provides data for pre- and post-operative evaluations. However, in spite of the increasing application of

both evaluation methods, no study has yet been conducted to examine the correlation between the results obtained by the subjective evaluation of VHI and the objective evaluation of VLM.

This study attempts to answer the following questions: (1) What is the level of correlation between VHI and VLM? (2) What is the level of correlation between the three factors (emotional, physical, functional) in VHI? (3) What is the level of correlation between the four factors in VLM?

Materials and methods

Selection of patients

Between August 2000 to February 2001, 79 patients with dysphonia underwent VHI testing at the Tri-Service General Hospital in Taipei, Taiwan. The diagnosis of dysphonic patients included vocal mass or polyp (n = 26), functional voice disorder (n = 12), and glottic insufficiency (n = 41). Glottic insufficiency resulted from a variety of factors, including vocal scarring, bowing, sulcus and paralysis.

VHI measurement

Seventy-nine patients underwent VHI evaluation prior to treatment. VHI, proposed by Jacobson et al. [3] in 1997, comprises ten voice disorder variables in three domains [emotional (E), physical (P) and functional (F)]. Patients are requested to note their frequency of each variable on a five-point scale (never, almost never, sometimes, almost always, always). The VHI is scored pre-operatively for dysphonic patients on a 1 to 5 scale (1 = never, 5 = always). Scores in each domain (E, P and F) ranged from 10 (unaffected) to 50 (severely affected). The total score ("T") sums E, P and F. The T score ranges from 30 (unaffected) to 150 (severely affected). Scores were also tabulated for each domain and combined domain total.

Voice Laboratory Measurements (VLM)

Fifty-six patients underwent acoustic recording and phonatory function studies in a soundproof room using established testing controls. A professional technician performed the testing and analysis. A microphone was fixed at a distance of 15 cm from the mouth of the patient being tested. Patients were requested to sustain a vowel "e" sound and a 2-s sample of the recorded data was used for analysis by Computer Speech Laboratory Software (Dr. Speech, Version 4, Tiger DRS, Inc.). From the recorded sample data, jitter (J), shimmer (S) and harmonic-to-noise (H) ratio values were tabulated. A maximal phonation time "M" was measured using a computer cursor over a waveform display of the airflow and acoustic signals. Data were organized on a spreadsheet for analysis.

Statistical analysis

E, P, F, T, J, S, M and H were entered into a statistical program, and the variables of each were analysed using Pearson's correlation. The statistical significance was defined as $P < 0.05$.

Results

Study population

There were 79 patients in the initial study group; 34 (43%) were male. The average age was 50.5±13.5 years (actual range 18–79 years).

VHI and VLM

Of the 79 patients requested pre-operatively to fill out the VHI measurement form, only 56 of 79 completed VLM for use in this study.

VHI reliability

Overall, the reliability for the four domains of VHI was excellent (Table 1). For the P domain of VHI, r values for P, E and T domains, using Pearson's correlation, are 0.778, 0.764 and 0.913, respectively ($P < 0.01$). For the F domain of VHI, r values for E and T domains, using Pearson's correlation, are 0.883 and 0.949, respectively ($P < 0.01$). For the E domain of VHI, the r value for the domain, using Pearson's correlation, is 0.942 ($P < 0.01$).

Reliability of VLM

Overall, the reliability of four items of VLM was excellent (Table 2). For the J variable of VLM, the r values for S, M and H, using Pearson's correlation, are 0.530, –0.238 and –0.463, respectively ($P < 0.01$). For the S variable of VLM, the r values for M and H, using Pearson's correla-

Table 1 Correlation between four domains of Voice Handicap Index (*VHI*) by each other (n = 79) (P Physical, F Functional, E Emotional, T Total)

	P	F	E	T
P	1	0.778*	0.764*	0.913*
F	0.788*	1	0.883*	0.949*
E	0.764*	0.883*	1	0.942*
T	0.913*	0.949*	0.942*	1

*$P < 0.01$

Table 2 Correlation between four items of Voice Laboratory Measurements (VLM) by each other (n = 56) (J jitter, S shimmer, M maximal phonation time, H harmonic-to-noise ratio)

	J	S	M	H
J	1	0.530*	–0.238*	–0.463*
S	0.530*	1	–0.219	–0.593*
M	–0.238*	–0.219	1	0.394*
H	–0.463*	–0.593*	0.394*	1

*$P < 0.01$

Table 3 Correlation between VHI and VLM (n = 56) (J jitter, S shimmer, M maximal phonation time, H harmonic-to-noise ratio, VHI Voice Handicap Index, P physical, F functional, E emotional, T total)

	P	F	E	T
J	–0.010	0.084	0.147	0.079
S	0.113	0.113	0.180	0.145
M	–0.070	–0.040	0	0.238
H	–0.172	–0.270*	–0.173	–0.220

*$P < 0.05$

tion, are –0.219 and –0.593, respectively ($P < 0.01$). For the M variable of VLM, the r value for H, using Pearson's correlation, is 0.394 ($P < 0.01$).

Correlation between VHI and VLM

Correlation between VHI and VLM are shown in Table 3. For the P domain of VHI, r values for J, S, M and H of VLM, using Pearson's correlation, are –0.010 (P = 0.94), 0.113 (P = 0.41), –0.070 (P = 0.61) and –0.172 (P = 0.21), respectively. For the F domain of VHI, r values for J, S, M and H of VLM, using Pearson's correlation, are 0.084 (P = 0.54), 0.113 (P = 0.41), –0.040 (P = 0.77) and –0.270 ($P < 0.05$), respectively. For the E domain of VHI, r values for J, S, M and H of VLM, using Pearson's correlation, are 0.147 (P = 0.28), 0.180 (P = 0.18), 0 (P = 0.99) and –0.173 (P = 0.21), respectively. For the T domain of VHI, r values for J, S, M and H of VLM, using Pearson's correlation, are 0.790 (P = 0.57), 0.145 (P = 0.29), 0.238 (P = 0.74) and -0.220 (P = 0.11), respectively. Overall, the correlation between VHI and VLM is poor.

Discussion

In 1997, Jacobson et al. [3] developed a methodology, the Voice Handicap Index (VHI), to measure the severity of voice handicaps by examining patients' emotional, physical, and functional factors. As already noted, while voice laboratory measurements such as jitter, shimmer, noise-to-harmonic ratio and maximal phonation time provide certain insights regarding voice impairment severity as compared to the expected normal voice, they fail to indicate why patients with similar voice disorders experience different levels of handicap severity [4]. VHI, by considering this issue, represents a significant new development in the field of voice dysfunction.

VHI consists of 30 variables categorized into three domains. In our study, there was a strong correlation ($P < 0.01$) between each domain for dysphonic patients. This indicates that voice problems affect multiple aspects of a patient's life, including emotional, physical, functional, economic and others. Therefore, symptoms of dysphonic disease include not only a husky voice, but also run deeper to include complex problems for each patient.

Jitter, shimmer, noise-to-harmonic ratio and maximum phonation time of VLM are routinely observed in order to benchmark a patient's condition, both pre-operatively and post-operatively. These measurements are objective in nature and yield information very useful for treatment efficiency. In our study, VLM parameters collectively show a strong correlation ($P < 0.01$) for dysphonic patients pre-operatively. This indicates that these parameters are sufficiently sensitive and reliable to assess disease severity. However, there is a large discrepancy between the measurements returned by VHI and VLM. A patient's subjective feelings regarding his/her dysphonic problem cannot be evaluated using objective measurements. This resulted in our frequent observation of patients who did not rate their treatment as particularly effective despite excellent VLM test results.

Glicklich et al. proposed a voice outcome survey (VOS) to examine treatment results in patients with vocal fold paralysis [2]. They concluded that VOS is a brief, valid, reliable and sensitive tool to evaluate clinical change in patients with unilateral vocal fold paralysis. However, VOS incorporates only five questions and thus cannot address patients' physical, functional and emotional voice disorder aspects in any depth. Moreover, Glicklich's study indicates that VOS does not validate all aspects of dysphonic patients.

For many years, clinicians relied solely on the VLM test to assess the needs of their dysphonic patients. These measurements, although extremely useful in evaluating treatment efficacy, do not offer an understanding of the subjective perceptions of dysphonic patients. While VHI research is only in its beginning stages, it has proven useful to identify a patient's perception of his/her voice disorder. We gathered significant subjective data from many aspects of VHI. These data can provide valuable input into the pre-operative evaluation process. However, there remains a large discrepancy between VHI and VLM. This discrepancy indicates that no objective parameter can be regarded as a prognostic factor to evaluate subjective perception of dysphonic patients. Our hope is that others will develop a measurement of voice disorder which include three or more patient evaluation domains and display strong correlation with the VLM testing methodology.

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